Morphological diversity within the genus *Eria* (Orchidaceae) in India[a]

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Abstract

The present paper offers a description of the natural history of the genus *Eria* J.Lindley (Orchidaceae) in India, including detailed information about the range of diversity in respect to vegetative and floral characteristics. The data provided is complemented by representative illustration materials.

Résumé

Diversité morphologique au sein du genre *Eria* (Orchidaceae) en Inde – Cet article s'intéresse à l'histoire naturelle du genre *Eria* J.Lindley en Inde et propose des informations détaillées sur la diversité des caractères végétatifs et floraux. Des illustrations représentatives complètent ces données.

Introduction

The genus *Eria* is one of the largest and most polymorphous groups of Orchids, comprising about 370 taxa (Mabberley, 2008). *Eria* is closely allied to the genera *Trichotosia* Blume and *Porpax* Lindley but differs from those by having glabrous leaves and sheaths, free lateral sepals, and 8 pollinia in two groups of four, joined together by their caudicles to a common elastic and viscid substance. Studies in context of the preparation of a modern *Flora of India* have shown that 60 taxa (57 species and 3 varieties) belonging

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to the genus *Eria* are present within the boundaries of the country (Agrawala, 2009).

Due to the great variations throughout the genus, *Eria* has been divided into several sections by grouping species with a similar set of characters. The taxa occurring in India belong to thirteen of these sections.

Section *Eria* (autonym)
Section *Bambusifolia* Hooker fil.
Section *Conchidium* Lindley
Section *Cylindrolobus* Blume
Section *Dendrolirium* Blume
Section *Hymenaria* Lindley,
Section *Myceranthes* Reichenbach fil.
Section *Pinalia* Lindley
Section *Secundae* Leavitt
Section *Strongyleria* Pfitzer
Section *Trichosma* Lindley
Section *Tylostylis* Lindley
Section *Xiphosium* Lindley

The present paper aims to provide full generic description of the genus *Eria* as it is present in India, including detailed information about the diversity in respect to all possible aspects of the various species. The data as presented was obtained through the study of an extensive number of life specimens in the wild and in cultivation, an extensive study of available herbarium materials, and an in-depth literature survey. Photographs are provided for better understanding of the morphological diversity.

Morphological diversity

Habit. Most plants of the genus *Eria* found in India grow as epiphytes. Some, however, are also found growing rupiculously on moist, moss-covered rock structures on large, hilly slopes. *Eria reticosa* Wight is generally growing as an epiphyte, but some plants have been found growing lithophytically on the perpendicular rock faces of the Panchagani plateau in Maharashtra. In general, plants belonging to the genus *Eria* do not seem to be host specific and are found on the trunks and branches of a wide variety of different woody plants with a rough bark, where they settle and grow in moss. All species have a sympodial growth pattern. The size of the plants varies from a few centimetres (section *Conchidium)* to more than a meter (sections *Bambusifolia* and *Cylindrolobus)*. Most of the species grow erect, whereas *Eria paniculata* Lindley is arcuate in its growth habit (Plate 1).

Roots. Generally, the roots of *Eria* species develop from nodes on the rhizome at the base of the pseudobulbs, but in the plants belonging to section *Dendrolirium* roots are generated from nodes over the entire length

Plate 1: different types of habits within the genus *Eria*

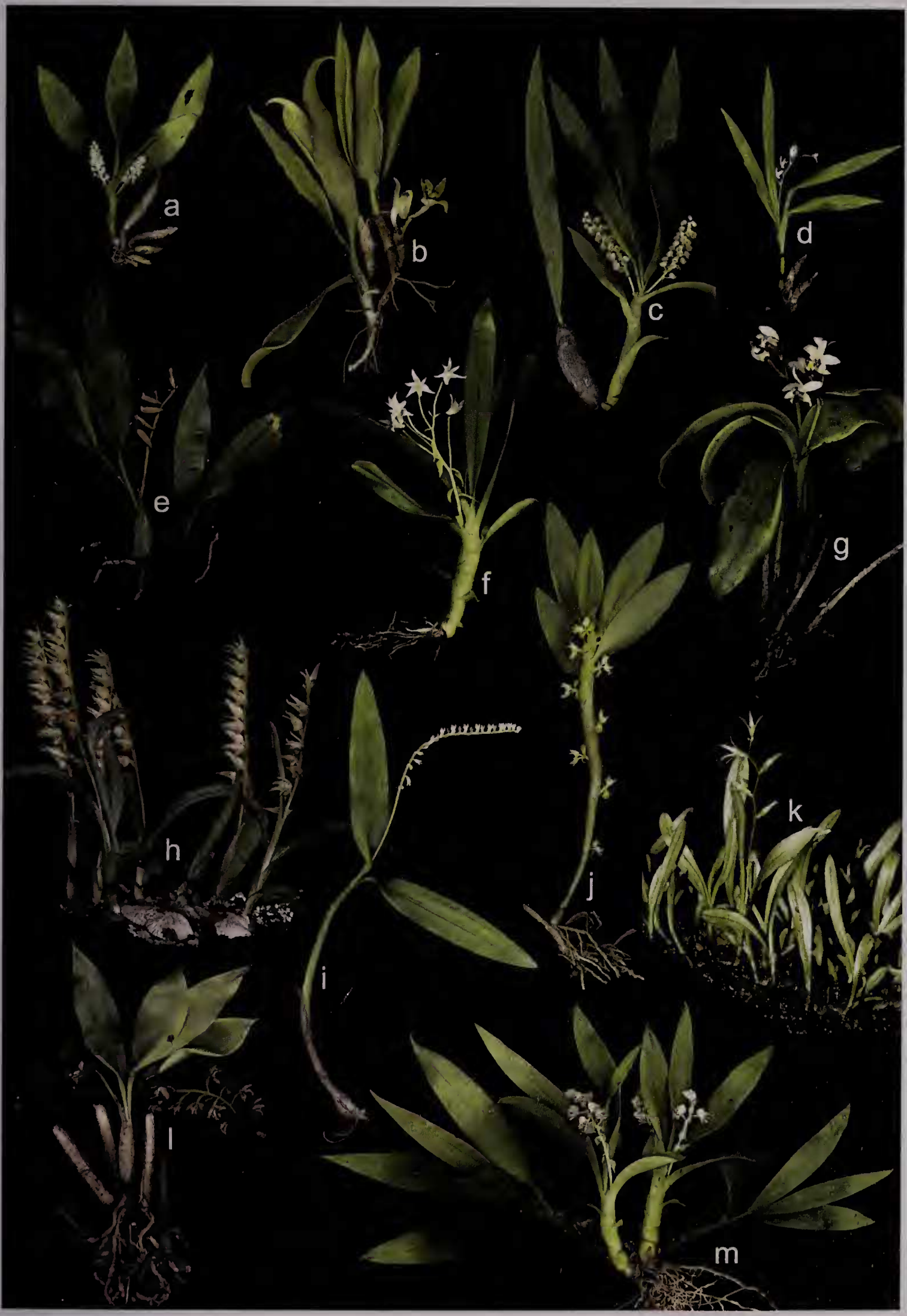
(opposite)

a). *E. globulifera*, b). *E. lasiopetala*, c). *E. bipunctata*, d). *E. alba*, e). *E. clausa*, f). *E. acervata*, g). *E. coronaria*, h). *E. filiformis*, i). *E. stricta*, j). *E. biflora*, k). *E. microchilos*, l). *E. vittata*, m). *E. occidentalis*. All photographs are not to scale.

of the rhizome. Species belonging to the sections *Eria* and *Trichosma* have thick, velamenous roots at the base of their pseudobulbs, whereas the roots of all other Indian *Eria*-species are slender, wiry, strong and quite extensive. Roots of all species are either hirsute or tomentose in texture.

Rhizome. Being sympodial in growth habit, all species of *Eria* grow vertically upwards for a season and produce the growing point for the next season at the base of previous year's growth. This results in continuous horizontal growth. This horizontal stem is known as the rhizome. From this rhizome vertical pseudobulbs are generated at regular intervals. The intervals between the pseudobulbs in sections *Hymenaria, Pinalia, Eria, Trichosma, Cylindrolobus, Bambusifolia, Secundae* and *Myceranthes* are short, whereas the intervals between the pseudobulbs in the sections *Dendrolirium, Tylostylis, Strongyleria* and *Xiphosium* are between 5 and 15 cm. The rhizomes can be slender or stout. In section *Conchidium* rhizomes are slender and mostly coiled around and masked under the caespitose pseudobulbs. However, in *Eria pusilla* (Griffith) Lindley the slender rhizome grows horizontally and bears pseudobulbs at a distance of 3 to 8 cm. In section *Strongyleria*, rhizomes are slender, and creeping, and covered entirely with white-tomentose, funnel shaped sheaths. The distance between the pseudobulbs in this section is 3 to 6.5 cm. In all other species, the sheaths are glabrous.

Pseudobulbs/stems. The vertical annual growth *Eria* is either thickened or reed-like. For convenience and better understanding, the term pseudobulb is used in the present work for all the species. These show considerable range of variation within the genus. They consist of a single internode in sections *Conchidium, Trichosma, Xiphosium, Secundae* and *Eria*, two to three reduced internodes in sections *Hymenaria, Strongyleria, Pinalia, Dendrolirium* and *Tylostylis*, or several well developed internodes in sections *Bambusifolia, Cylindrolobus* and *Myceranthes.* The shape of the pseudobulbs varies considerably. In section *Conchidium* they are dorso-ventrally compressed, in sections *Cylindrolobus, Myceranthes* and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Bambusifolia they are long and cylindrical like reeds, in sections *Eria, Xiphosium* and in some species of sections *Dendrolirium* and *Trichosma* there are ovoid to fusiform. Pseudobulbs in *Eria coronaria* (Lindley) Reichenbach fil. and *Eria stricta* Lindley are narrow, cylindrical and elongated. In Section *Tylostylis* they are spindle-shaped and with distinct furrows. In many species like *Eria lasiopetala* (Willdenow) Ormerod and some members of sections *Hymenaria* and *Pinalia,* the pseudobulbs are bilaterally compressed. Depending upon the amount of annual growth in the rhizome, pseudobulbs are either clustered closely together, or are generated at some distance from each other along the rhizome. The size of the pseudobulbs varies from minute in section *Conchidium* to large and elongated in sections *Myceranthes, Cylindrolobus* and *Bambusifolia*. In *Eria pauciflora* Wight the pseudobulbs are narrow, cylindrical towards the base and swollen at the apex giving a light-bulb-like appearance. In *Eria pseudoclavicaulis* Blatter and *Eria clavicaulis* Wallich ex Lindley the pseudobulbs are narrow at base and clavate towards the apex. Normally, young new growths are generated from the base of mature pseudobulbs. These shoots are completely covered by sheaths at their base and engulfed in sheathing leaf-bases towards the apex. On maturity, the overlapping sheaths become separated and often modified in various ways. In most of the species of *Conchidium* the basal sheaths become withered and form raised epidermal veins above the pseudobulbs. In *Eria reticosa* the large sheath covering the pseudobulb becomes detached from the surface, the entire laminar portion is lost, leaving behind a net-like reticulate sheath formed by the veins. In the rest of the species the sheaths are confined to the base of the pseudobulbs and may or may not be overlapping. Overall, the pseudobulbs are completely glabrous, only in *Eria pannea* Lindley the sheaths are white-tomentose on the outside.

Leaves. The leaves of all species belonging to the genus *Eria* are completely glabrous. Their size varies from a few millimetres in section *Conchidium,* up to 40 to 50 cm in *Eria paniculata, Eria javanica* (Swartz) Blume. They are medium sized in sections *Hymenaria, Pinalia, Bambusifolia,* and *Dendrolirium.* In most cases, the leaves are sub-coriaceous, but in section *Conchidium* they are membranous. As in most monocots, the leaves in the genus *Eria* have sheathing leaf-bases. Some species have short, channelled petioles at the base, whereas in *Eria carinata* Gibson ex Lindley the mature leaves have a long, round petiole. Leaf shape varies from terete in *Eria*

pannea to narrow-linear in *Eria paniculata*, elliptic-lanceolate or oblong-lanceolate in a great number of species, to broadly lanceolate-oblong in *Eria javanica*. The leaves of the plants belonging to section *Conchidium* are oblanceolate-spathulate to obovate. Leaf margins in most species are entire but in some species of section *Conchidium* they are shortly ciliate or papillate. Leaf apices are mostly acuminate, occasionally obtuse-emarginate as in *Eria carinata* and members of section *Tylostylis* and rarely long-apiculate as in *Eria pusilla* which has a long bristle at the apex. Whereas most of species belonging to sections *Eria*, *Trichosma*, *Secundae* have two leaves at the apex of their pseudobulbs, 3 to 5 leaves arise from the apical or sub-apical portion of the stems in sections *Conchidium*, *Hymenaria*, *Cylindrolobus*, *Pinalia* and *Dendrolirium*.
In Sections *Bambusifolia* and in *Eria paniculata* multiple leaves are generated over the entire length of the stem. Generally the leaves are conduplicate, only in the Section *Eria* they are plicate and show many prominently raised veins.

Inflorescence. The inflorescence is a simple raceme in most of the species, a branched panicle in *Eria paniculata* and *Eria bambusifolia* Hooker fil., a dense spike in *Eria spicata* and a 2-3-flowered cyme-like inflorescence in Section *Cylindrolobus*. The number of flowers varies considerably from single flowers in *Eria reticosa*, *Eria braccata* Lindley and *Eria pusilla* to multiple flowers in *Eria stricta*, *Eria paniculata*, *Eria spicata* (D. Don) Handel-Mazzetti etc. The relative length of the inflorescence as compared to the leaves varies from species to species as does the mode of development. In most monsoon-flowering species the inflorescence develops simultaneously with the development of leaves, whereas in summer-flowering species, the inflorescence develops after complete maturation of the leaves. In *Eria extinctoria* (Lindley) Oliver, *Eria lacei* Summerhayes and *Eria exilis* Hooker fil., the inflorescence develops after leaf-fall. Peduncle and rachis in most of the species are pubescent to tomentose, but in section *Conchidium* they are entirely glabrous. In most of the species, the peduncles are sheathed at their base, and in other species there are sterile bracts below the rachis. The number and position of the inflorescences vary in different species. In section *Dendrolirium* and in *Eria extinctoria* the inflorescences are often generated in pairs. In section *Cylindrolobus* they arise from cavities opposite the leaf-axils. In sections *Eria*, *Conchidium*, *Trichosma* and *Myceranthes* there is only a single inflorescence, generated from the top of the pseudobulbs.

Plate-2: flowers in the genus *Eria*

(opposite)

a). *E. vittata*, b). *E. bambusifolia*, c). *E. acervata*, d). *E. coronaria*, e). *E. alba*, f). *E. amica*, g). *E. graminifolia*, h). *E. bipunctata*, i). *E. ferruginea*, j). *E. lasiopetala*, k). *E. tomentosa*, l). *E. globulifera*, m). *E. stricta*, n). *E. coronaria* (side view), o). *E. biflora* (side view), p). *E. biflora*, q). *E. spicata*, r). *E. amica* (side view), s). *E. alba* (side view), t). *E. glandulifera*, u). *E. paniculata*. All photographs are not to scale

Rachis are generally straight, but in *Eria exilis*, these are strongly flexuous. In *Eria spicata*, *Eria vittata* J. Lindley, *Eria javanica* and *Eria coronaria* the rachis are horizontally arched.

Floral bracts. All the species of the genus *Eria* have bracteate flowers. The floral bracts vary in shape, size, texture and colour and are taxonomically significant. They are membranous, ovate-lanceolate to cymbiform in section *Conchidium* and large, ovate, colourful in section *Cylindrolobus*. They are inconspicuous in section *Trichosma*, and large, leafy in *Eria kamlangensis* Nageswara Rao, *Eria tomentosa* (Koenig) Hooker fil., *Eria ferruginea* Lindley and *Eria andamanica* Hooker fil. In *Eria paniculata* and members of section *Pinalia* the floral bracts are strongly reflexed. In general, the floral bracts are sparsely pubescent to woolly tomentose outside, but in Section *Conchidium* they are completely glabrous. The length of the floral bracts and the pedicel plus ovary is often a taxonomically useful characteristic.

Flowers. Flowers vary in size, colour, odour, indumentation and orientation. Among the Indian *Eria*, the size of flowers vary from about 4 mm to about 3 cm. Whereas *Eria javanica*, *Eria coronaria*, and *Eria alba* Lindley produce fragrant flowers, other species do not have any fragrance. Most of the species have inconspicuous, dull coloured flowers and are therefore neglected in horticulture. *Eria reticosa*, *Eria braccata*, *Eria coronaria*, *Eria carinata*, *Eria javanica*, *Eria vittata*, and members of sections *Pinalia* and *Hymenaria*, however, generate large, colourful, and attractive flowers that are very much of interest to the horticulturist. The ovary is stalked or sessile. The flowers are invariably resupinate. In most of the species, the flowers are spreading but in *Eria clausa* King & Pantling, *Eria stricta*, *Eria exilis* and *Eria discolor* Lindley flowers do not fully open. (Plate-2)

Sepals. In all species, the dorsal sepal is always different from the lateral sepals in size, shape, venation, and/or texture. In most species, dorsal sepals are oblong-lanceolate to ovate-lanceolate, entire, acute, acuminate to


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Plate-3: lip profile in the genus *Eria*

(opposite)

a). *E. vittata,* b). *E. stricta,* c). *E. paniculata,* d). *E. spicata,* e). *E. occidentalis,* f). *E. globulifera,* g). *E. bipunctata,* h). *E. coronaria,* i). *E. lasiopetala,* j). *E. acervata,* k). *E. alba,* l). *E. amica,* m). *E. graminifolia,* n). *E. biflora,* o). *E. bambusifolia.*

obtuse, 3-5-7-veined. The lateral sepals are slightly falcate in all the species. Sepals are generally pubescent, puberulent, villose or tomentose externally, but in section *Conchidium* they are completely glabrous. The base of the lateral sepals is united with the column-foot, thus forming a chin-like mentum which is of taxonomic significance within the genus. *Eria extinctoria* has the largest mentum, which is elongated like a spur. In most species, the mentum is entire, in some, however, it is bi-lobed or shallowly emarginate. In *Eria carinata* the lateral sepals are strongly keeled.

Petals. The inner petal is variously modified into a lip (labellum) of various shape and ornamentation (see below). The outer two petals are similar in every respect. Their shape, size and venation is different from species to species. These characteristics are significant taxonomic parameters. The petals are membranous, 3-5-7-veined, elliptic-lanceolate, falcate, acute, and acuminate to obtuse. In general, they are glabrous, but in *Eria lasiopetala* the petals are sparsely pubescent.

Lip. Due to the resupination of the ovary, the lip takes the outermost position corresponding to the axis. The pattern of coloration, the number of lobes, and the texture and ornamentation is highly specific and is the most important taxonomic tool. The characters are not even shared by the members within same section. In most of the species, the lip is immobile, fixed to the apex of the column-foot, and a demarcating line between the foot and the lip is clearly visible. In section *Tylostylis*, however, the lip is movable, and in section *Pinalia* there is no demarcation line between column-foot and lip. In most species of the genus *Eria*, the lip is more or less clearly trilobate and stands at an acute angle to the column-foot. The side-lobes of lip often overlap the apex of the column. Margins vary from entire to crenulate, undulate or glandular. Number, texture and nature of calli also vary from species to species. (Plate-3)

Column. In *Eria*, as in all orchids belonging to subfamily Epidendroideae, the anther is loosely attached at the top of the column by a slender filament. There are three anthers of which only the middle one is fertile.

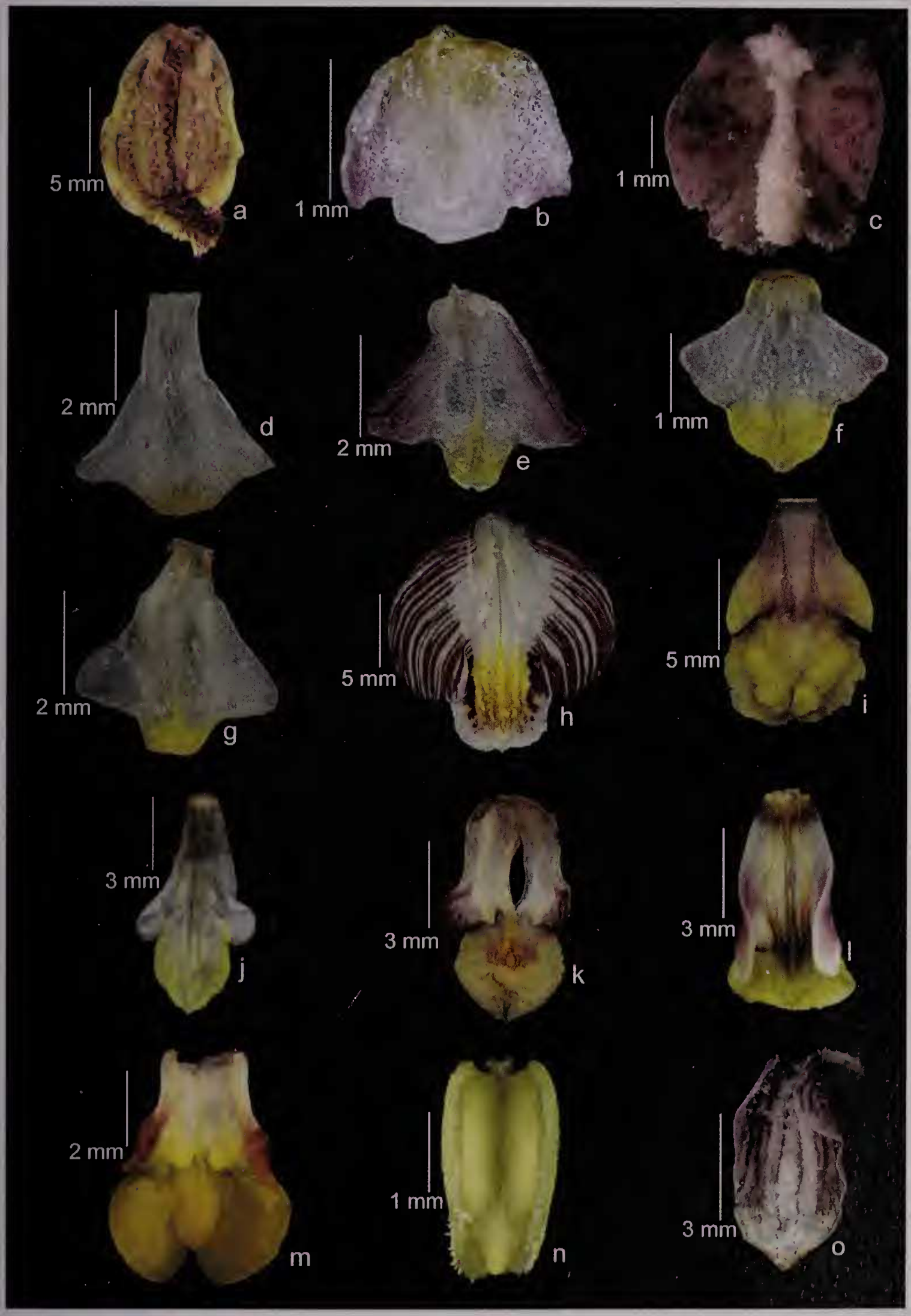
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Plate-4: anthers and pollinia in the genus *Eria*

(opposite)

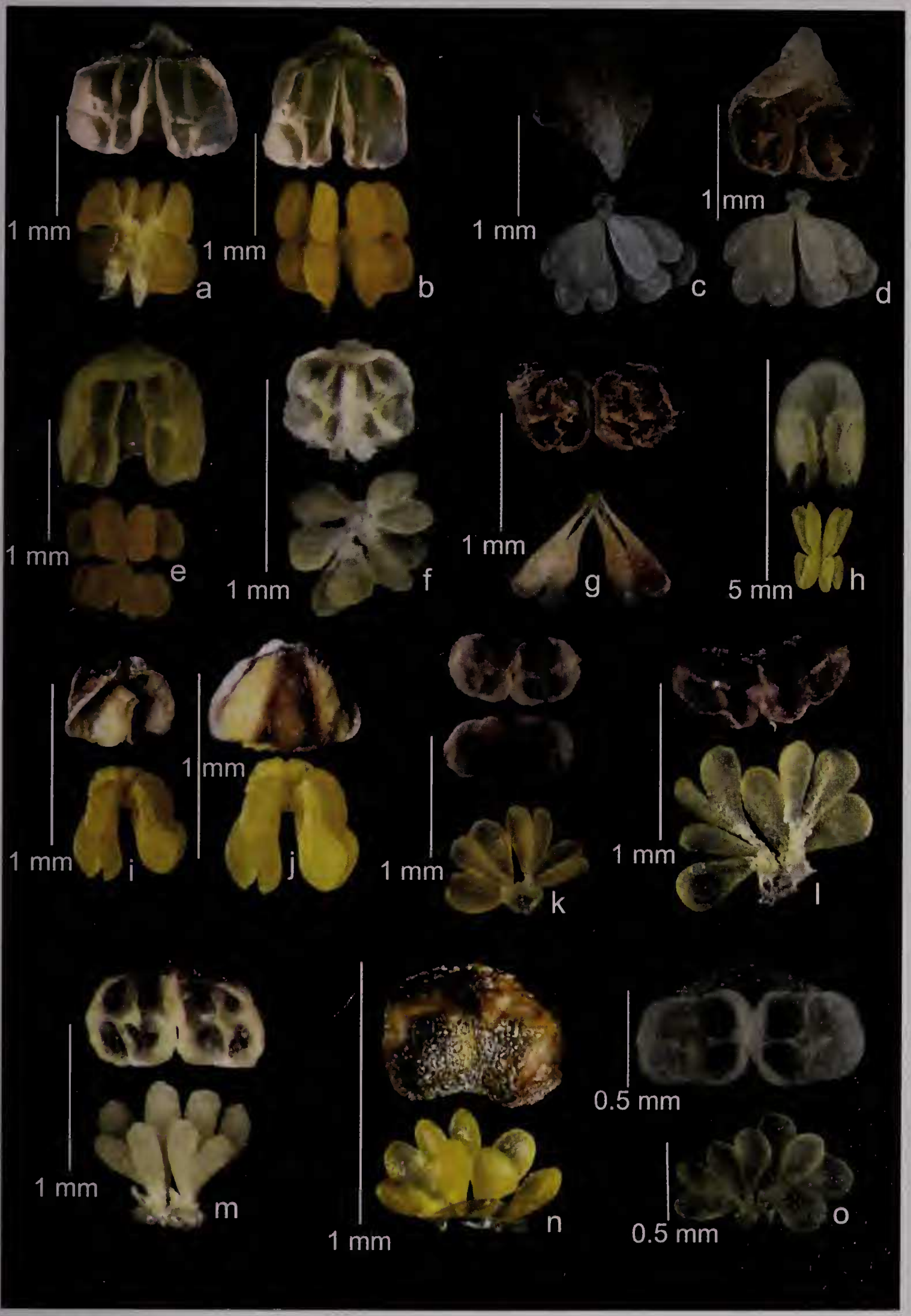
a). & b). *E. acervata*, c). & d). *E. alba*, e). *E. amica*, f). *E. biflora*, g). *E. graminifolia*, h). *E. coronaria*, i). & j). *E. lasiopetala*, k). *E. bipunctata*, l). *E. occidentalis*, m). *E. spicata*, n). *E. stricta*, o). *E. globulifera*.

The sterile anthers are not visible as a staminode, but sometimes they are merged with the main body of column to form columnar wings. Columns in all species of *Eria* have a column foot. The dimensions of the column and column foot are specific and therefore useful in taxonomy.

Anthers and pollinia. The single fertile anther lies at the top of the column. The area of the column where the anther seats is known as the clinandrium. The structure of the anther is specific, but there are always two lobes that are divided into four chambers each. The colour and shape of the dorsal surface varies from species to species. All *Eria* species have 8 pollinia, corresponding to the 8 chambers of the anther. The pollinia are grouped together into two groups of four pollinia which are joined by their caudicles into an elastic, viscous substance. This is the only unique character that applies to all species within the genus *Eria*. In some members of section *Conchidium*, each pollinary group have two well developed and two rudimentary pollinia. The shape of the pollinia varies from clavate, discoid and pyriform to reniform. In all species, the pollinia are waxy or cartilaginous. (Plate-4)

Stigmas. Two of the stigmas are functionally receptive. They are located below the clinandrium in the apical part of the column and form a cavity filled with sticky viscous substance. The shape and size of this cavity varies from species to species. The third stigma is modified into a barrier between the anther and the fertile stigma, thereby preventing self- pollination. This is referred to as the rostellum. The shape of the rostellum varies from tongue-shaped to reniform. In most members of section *Hymenaria* there are two slender appendages at the base of each functional stigmatic cavity.

Pedicel and ovary. The ovary is continuous with the pedicel (if present) or stalk of the flower but can be differentiated from the pedicel by its ridged surface. In sections *Conchidium*, *Pinalia*, *Myceranthes* and *Secundae* the ovaries are either sessile or have a very small, inconspicuous pedicel. In most of the species, pedicel and ovary are pubescent to tomentose, but in section *Conchidium* they are glabrous. The size varies from about 2 mm to about 3 cm.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Fruits and seeds. The fruit of all species belonging to the genus *Eria* is a capsule that may be stalked or sessile depending upon whether the ovary has a pedicel or not. The fruit invariably show 3 to 6 ridges. The shape of the capsule varies from obpyriform-globose-ovate to oblanceolate-oblong and elliptic-lanceolate. In general, the fruit is pubescent at least at some stage of its development. In section *Conchidium*, however, the fruit is glabrous. The young capsules show marcescent floral parts attached to their apex. Inside the capsules, the placenta becomes matured and develop into fibrous, cottony structures to which numerous microscopic seeds are attached. Placentation is parietal and the three placentas remain as three cottony ridges inside the capsule. Seeds are ex-albuminous and without any endosperm.

Conclusion

Seidenfaden (1982), under his treatment of *Eria* in Thailand, commented "this genus as circumscribed by Lindley and as understood by later authors, has had so many rather heterogeneous elements included that considerations must be given to possible separations in into more genera". In the same work, Seidenfaden separated *Trichotosia* as an autonomous genus and wrote: "One reason [to separate *Trichotosia* from *Eria*] is that it seems natural to foresee the future division of *Eria* into several genera". The range of diversity observed in the present study for the genus within India ratifies the above statement. But the circumscription of a genus has always to be delimited based on a monographic study of the entire genus. Revisionary studies in regional context can only provide the basic information at the level of species.

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